

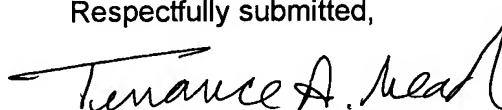
REMARKS

Claims 2-76 have been cancelled. Claims 77-94 have been added. Claims 1 and 77-94 remain in the application.

The Title, Abstract, Drawings and Specification have been amended.

This Preliminary Amendment is submitted in a Divisional application claiming priority from US patent application 09/546,078. The amendments made in this paper conform the descriptive portions of this application to the non-elected invention in the '078 application. The claims that have been added are directed to the non-elected subject matter in the '078 application, but have a broader scope than the originally-filed, and later cancelled, claims that were directed to that subject matter. No new matter has been entered.

Respectfully submitted,



TERRANCE A. MEADOR
Reg. No. 30,298

Date: 17 December 2001

GRAY CARY WARE & FREIDENRICH
4365 Executive Drive, Suite 1100
San Diego, CA 92121-2133

Telephone: 858/638-6747 Fax: 858/638-6727

VERSION WITH MARKINGS SHOWING CHANGES MADE
IN THE SPECIFICATION

Page 1, lines 5-8:

This is a divisional of application Serial No. 09/546,078, entitled CONTROL AND DETECTION OF A CONDITION BETWEEN AN INFLATABLE THERMAL DEVICE AND AN AIR HOSE IN A CONVECTIVE WARMING SYSTEM, invented by Van Duren et al, and filed on April 10, 2000, which is a continuation in part of prior application Serial No. 09/138,774, entitled DETECTION A CONDITION BETWEEN AN INFLATABLE THERMAL DEVICE AND AN AIR HOSE IN A CONVECTIVE WARMING SYSTEM, invented by Van Duren et al., and filed on August 24, 1998.

Page 1, lines 11-22:

This invention relates to pressurized thermal systems that regulate human core temperature by convecting pressurized, thermally regulated air. More particularly, the invention relates to inflatable thermal blankets and the like that are used, for example, in a medical setting to deliver a bath of pressurized air which is heated, cooled, or ambient temperature, for the treatment of hypothermia or hyperthermia. In particular, pressurized, thermally regulated air is used to inflate such a device and is expelled there from onto a person or animal. Still more particularly, the invention relates to controlling the flow of pressurized air through the end of an air hose in response to coupling and decoupling the end to the inlet port of an inflatable thermal device [monitoring the operation of a pressurized thermal device in order to detect and respond to a potentially hazardous condition of its operation. Further, the invention relates to the identification of an inflatable thermal device and controlling the delivery air in response to the identification so that special services can be provided based on patient identity or inflatable device model number].

Page 3, lines 20-26:

[None of the commercially-available convective warming systems have sensors in the inlet port to measure air flow temperature, which can result in uncertain and poorly controlled delivery of therapy. Some prior art devices, including devices made by the assignee of the instant application, have equipped the distal end of the air delivery hose (connected to the inlet port) with temperature sensors. However, these sensors can still be inaccurate, as they provide inaccurate readings if the hose is improperly connected to the inlet port.]

Page 4, line 13 through Page 5, line 2:

The invention is based on the critical realization that the junction between the distal (far) end of an air hose and an inlet port of an inflatable thermal device provides a location where the continuity of the air flow path [and the magnitudes of air flow characteristics such as temperature and pressure] can be [sensed or] regulated. [In this regard, a first circuit element may be provided that is integral with the pressurized thermal device at, in, or near an inlet port, while a second circuit element may be provided at, in, or on the distal end of the air hose. When the distal end of the air hose is received in the inlet port, the first and second circuit elements cooperate to provide a signal indicative of connection between the inlet port and the distal end. When the distal end of the air hose is not connected to the inflatable thermal device by way of the inlet port, the signal cannot be generated. Therefore, the presence or absence of the signal may be used to provide an indication of a connect/disconnect condition between the inlet port and the distal end of the air hose. Moreover, the information can be enriched by addition of one or more sensors at or near the junction between the inlet port and the distal end of the air hose to provide an indication of one or more air flow characteristics such as temperature or pressure, or both. It may be desirable to provide a power override function that turns off the heater/blower unit, modulates the temperature output of the unit, or places it in a standby condition in response either a disconnect condition indication or measurement of a temperature and/or pressure at the distal end of the air hose that deviates from a predetermined value.]

Page 5, lines 3-15:

[In particular, the above-described invention is made more useful by making the insertion of the distal end of the air hose into the inlet port independent of any kind of rotational alignment, so that the operators does not need to take the time to align keys. The rotational independence of the connection permits the air hose to be rotated while in use without breaking the electrical connection between the first and second circuit elements. The inlet port first circuit element can be of a conductive annular ring, a hose card with a conductive ink surface, or a wireless communications radiator. The invention is also made more useful by using the first and second circuit elements to communicate the identity of a specific inflatable thermal device. In one aspect, electrical impedance is measured to determine an inflatable device type to determine air flow characteristics. In another aspect, the first circuit element is connected to an

electronic identification tag to provide information such as device model number and patient identification.]

Page 5, lines 16-20:

In this regard, [In yet another aspect of the invention,] flow of air to the inflatable thermal device is controlled mechanically, with the insertion of the distal end of the air hose into the inflatable thermal device. Several valve mechanisms can be used to block air flow from the air hose when the hose is not properly seated in the inlet port. When inserted, the valves are forced open to provide air to the inflatable thermal device.

Page 5, lines 21-23:

Accordingly, it is an object to invent a convective warming system that includes a pressurized thermal device with the ability to [sense and] react to air flow conditions at a point where an air flow is provided through an inlet port of the device.

Page 5, lines 27 through 30:

[Another object is to identify the inflatable thermal device, and to modify the flow of air, air temperature, or both, in response to the identification.

Another object is to determine the number of times the pressurized delivery device (blanket) is used or connected to the heater/blower unit.]

Page 6, lines 8 through 9:

Fig. 2 is a block diagram showing the elements of [the invention and their relationships to each other and to the elements of] a convective warming system;

Page 6, lines 10 through line 14:

Fig. 3A and 3B illustrate an air hose, an inflatable thermal device and elements of a presence sensor [according to the invention] that monitors continuity of the connection between the distal end of the air hose and an inlet port of the device; Figs. 4A and 4B illustrate the elements of Figs. 3A and 3B, with the addition of an airflow sensor located at the inlet port;

Page 6, lines 21 through 22:

Figs. 8A and 8B illustrate how the proximal end of the air hose may be coupled to a heater/blower unit [according to the invention];

Page 7, lines 3 through 4:

Figs. 14A, 14B, 15A-15C, 16A, and 16B illustrate alternate embodiments [some example] of mechanical solutions to the problem of controlling air flow to an inflatable thermal device according to the invention.

Page 7, lines 5 through 8:

[Fig. 17 illustrates a method for indicating a condition in a system including an inflatable thermal device, corresponding to Figs. 11A-11C, and Figs. 12A-12C.

Fig. 18 is a flowchart illustrating a method for indicating a condition in a system including an inflatable thermal device, corresponding to Figs. 13A and 13B.]

Page 7, lines through 11:

Fig. 17 [19] is a flowchart illustrating a method for controlling air flow in a system including an inflatable thermal device, corresponding to Figs. 14A-14B, 15A-15C, and 16A-16B

Page 7, line 23 through Page 8, line 9:

With greater specificity, the convective warming system of Fig. 1 includes an inflatable thermal device 10 having one or more inlet ports through which a flow of pressurized, thermally-regulated air is admitted to inflate the inflatable thermal device 10. One such inlet port is indicated by reference numeral 11. In the BAIR HUGGER⁷ family of inflatable thermal blankets, inlet ports typically comprise an opening into an inflatable structure and a stiff planar member of cardboard having an aperture. The planar member of cardboard is mounted to the inflatable structure such that the aperture in the member is aligned with the opening in the inflatable structure. The planar member is commonly referred to as a "hose card" because it provides a flat, card-like structural element that receives and supports the distal end of an air hose when the distal end is joined, mated, coupled or received in the inlet port. However, this invention is not intended to be limited to an inflatable thermal device with such inlet ports. [In fact, in the inflatable thermal blanket art many inlet port structures are known and include, for example, sleeves, openings, collars, and the like.] Furthermore, an inflatable thermal device may include more than one inlet port. In this regard, many models of inflatable thermal devices have two - and sometimes more - inlet ports located at various positions in order to provide flexibility in arranging the elements of a convective warming system.

Page 9, line 4 through Page 10, line 27:

Refer now to Fig. 2 [for an understanding of the invention. Although Fig. 2 includes a set of specifically-described elements, it is to be understood that wherever any such elements have structural and/or functional equivalents, such alternatives are considered to be within the scope of the invention.] In Fig. 2, a convective warming system [constructed and operated according to the invention] includes an inflatable thermal device (not shown) having one or more inlet ports, one of which is indicated by reference numeral 11. The distal end 14 of the air hose 12 is intended to be coupled to or received in the inlet port 11; however, these elements are shown separated in Fig. 2 [in order to more clearly illustrate the complement of elements that make up the invention]. The proximal end 15 of the air hose 12 is received in the port 19 of the heater/blower unit 18. The [invention contemplates the combination of the] just-described elements may be combined with a combination of elements that operate cooperatively to detect a condition between the distal end 14 of the air hose 12 and the inlet port 11 of the inflatable thermal device. These elements include a first circuit element 40 that is disposed in, on, at or near the inlet port 11. For example, the first circuit element 40 may be formed as an integral part of a hose card 30. A second circuit element 42 is located in, on, at, or near the distal end 14 of the air hose 12, and a signal path including one or more signal conductors 43 extends in or along the air hose 12 to the proximal end 15. At or near the proximal end 15 of the air hose 12, the signal path 43 is connected at connector 44 to the control unit 21 of the heater/blower unit 18. The combination of elements 40, 42 and 43 provides a circuit for detecting a condition that may develop or exist between the distal end 14 of the air hose 12 and the inlet port 11. In other words, these elements enable the generation, conduction, or detection of a signal that represents the condition. Such a condition may be embodied, for example, in the disengagement of the distal end 14 from the inlet port 11 while the heater/blower unit 18 is operating. Another condition, for example, could include a change in the temperature of the air flow through the distal end 14 or the inlet port 11, or through the junction formed between the distal end 14 and the inlet port 11 while the heater/blower unit 18 is operating. Yet another condition may be a change in the air flow velocity through the distal end 14 or the inlet port, or through the junction formed between the distal end 14 and the inlet port 11 while the unit 18 is operating. In this latter regard, the inverse of the condition would correspond to a decrease in the air flow resistance or a decrease in the air pressure at the distal end 14 of the air hose 12 or the inlet port 11, or in the junction between the distal end 14 and the inlet port 11 while the unit 18 is operating. Whatever the condition or conditions that [the invention is] these elements are deployed to detect, sensing is provided by cooperative operation between the first circuit

element 40 and the second circuit element 42 when the distal end 14 is joined, mated, coupled or received in the inlet port 11. In this regard, the junction formed between the distal end 14 and the inlet port 11 brings the first and second circuit elements 40 and 42 into close proximity and/or alignment. For so long as the proximity and/or alignment is maintained while the heater/blower unit 18 is operating, a first indication or signal may be generated and conducted on the signal path 43 to the control unit 21. A change in the condition is sensed by the cooperative operation of the first and second circuit elements 40 and 42, with the change in condition causing a change in the signal conducted on 43. A change in the signal conducted on 43 that is observed by the control unit 21 while the heater/blower unit 18 is operating causes the control unit 21 to take any one or more of a number of actions. First, the control unit 21 may simply cause the generation of a perceptible indication. In this regard, an indicator 46 may provide a visual and/or audible indication of a changed condition. In addition, or alternatively, the control unit 21 may respond to a change in condition by changing the motor speed of the blower 20 and/or the temperature of the warming element 24. Further, the control unit 21 may be designed or adapted to shut down or stop the operation of the heater/blower unit 18 altogether, or to place it in a standby state during which the temperature and/or velocity of the flow of air may be reduced.

Pages 10, line 28 through Page 11, line 3:

The cooperative operation of the first and second circuit elements can also provide a "first necessary condition" for starting the heater/blower unit 18, preventing it from being turned on, or becoming fully operational after being turned on, in response to disconnection or non-connection of the distal end 14 and the inlet port 11 prior to operation of the heater/blower unit 18. Stated another way, [the invention would permit] the heater/blower unit 18 may [to] be turned on, or [to] be fully operational only upon detection of joinder, coupling, or mating of the distal end 14 with the inlet port 11.

Page 11, line 4 through Page 12, line 28:

Figs. 3A and 3B illustrate [an embodiment of the invention wherein] how mating of the air hose distal end with the inlet port is detected and indicated. Although these figures illustrate an inlet port of a certain construction, those skilled in the art will realize that the principles represented in these figures can be applied to other air hose/inlet port configurations. In Figs. 3A and 3B, the hose card 30 is shown mounted on the inflatable thermal device 10 at the inlet port 11. The distal end 14 of the air hose has mounted to it a mechanism that aligns the distal

end 14 with the inlet port 11 thereby to join, couple, or mate these elements, or otherwise form a junction between them. The mechanism includes a planar member 50 having generally the same shape and construction as the hose card 30 with the addition of an extending edge 52 that transitions into a lip 53. The extending edge 52 extends substantially along three sides of the periphery of the planar member 50 so that the distal end 14 can be joined, mated, coupled or received in the inlet port 11 by engaging the edges 31 of the hose card 30 between the lip 53 and a surface of the planar member 50. In Figs. 3A and 3B, a first circuit element 55 is incorporated into the structure of the hose card 30 laterally of the opening in the hose card 30 that communicates with the inlet port 11. A second circuit element 57 is disposed in the planar member 50 laterally of the opening in the distal end 14 of the air hose 12. One or more signal conductors 58 are disposed in (or on) the air hose 12, extending from the distal end 14, along the air hose 12 toward its proximal end (not shown in these figures). Integration of signal wires into an air hose is within the ambit of modern manufacturing technology. Reference is given, for example, to vacuum cleaner hoses with embedded power conductors. In the figures, two electrical wires 58a and 58b are shown: their purpose is to conduct signals to the control unit 21. When the hose card 30 is received between the lip 53 and the planar member 50 so that the opening in the distal end 14 is aligned with the inlet port 11, the first circuit element 55 and the second circuit element 57 cooperate to complete or close a circuit between the one or more conductors 58a and 58b that is connected to the control unit 21. Many possible configurations of this circuit are possible for implementing as much [of the invention] as is illustrated in Figs. 3A and 3B. For example, the first circuit element 55 may comprise a magnetic member and the second circuit element 57 may comprise a reed switch or a Hall effect device. In this case, when the first and second circuit elements 55 and 57 are placed in close proximity by mating of the distal end 14 with the inlet port 11, the magnetic member 55 causes the reed switch to close, connecting the two electrical conductors 58a and 58b, thereby creating a signal pathway along which a signal may be conducted. Conversely, when the distal end 14 is disengaged from the inlet port 11, the first and second circuit members 55 and 57 will be moved apart, causing the reed switch to open, which will disable, interrupt or open the signal path just described. This of course will prevent the conduction of a signal. Other mechanisms may be used for the first and second circuit elements 55 and 57 and for the one or more conductors 58a and 58b. For example, the first circuit element 55 may comprise a spring-loaded bar of conductive material, while the second circuit element 57 may comprise two spaced-apart terminals or posts to which the electrical conductors 58a and 58b are respectively connected. When the first and second circuit elements 55 and 57 are in close proximity, it is contemplated

that the conductive bar in the hose card 30 would span and contact the posts, providing a conductive path there between. In yet another alternate implementation, the first circuit element 55 may comprise a spring-loaded, protruding member and the second circuit element 57 could comprise a mechanical switch that is operated by the protruding member when the distal end 14 is joined to the inlet port 11. In yet another implementation, the circuit could be an optical one in which the conductors 58a and 58b are optical fibers that terminate in optical connectors in the second circuit element 57. In this case, the first circuit element 55 could include an optical coupler that would complete an optical signal path between the ends of the two optical conductors. Alternatively, means exist for implementing an optical circuit using a single optical fiber terminated at the second circuit element 57 and a mirror incorporated in the first circuit element 55.

Page 14, line 26 through Page 15, line15:

Figs. 5C and 5D continue the illustration [of the invention] presented in Figs. 5A and 5B. Fig. 5C shows the planar member 50 engaged with the hose cord 30 thereby to join, couple, or mate the distal end 14 with the inlet port 11. Fig. 5D is a side sectional elevation view taken along lines D-D in Fig. 5C. In Fig. 5D, the air hose 12, has a conventional construction that includes a flexible side wall 12s. In addition, the conductors 58a and 58b are embedded in, formed in, or attached to the side wall 12s. The air hose 12 terminates at the distal end 14 in a cup-shaped plastic member 14a having a disk-shaped opening 14o. The rim of the plastic member 14a is attached to the planar member 50. The planar member 50 includes a first plate 50p, preferably a plastic piece to which the rim of the plastic member 14a is bonded or joined. Another plastic piece 50pp is attached to the plastic piece 50p; this piece 50pp includes the extending side wall 52 and the lip 53. The pieces 50p and 50pp are joined or otherwise bonded together to form the planar member 50 as a single, unitary piece. The thermocouple 57c is held between the two pieces 50p and 50pp and includes a portion that extends across an opening 50o provided through the planar member 50. The hose card 30 includes two planar pieces 30p and 30pp that are glued or bonded together. An opening 30o in communication with the inlet port 11 aligns with the openings 50o and 14o so that an air flow path extends through the air hose 12 and the openings 14o, 50o and 30o. One contact 57a is fixed in the planar member 50 at a location where it is contacted by the shorting bar 55 when the planar member 50 is seated on the hose card 30 as shown in Figs. 5C and 5D.

Page 17, lines 1 through 26:

Figs. 9, 10A and 10B illustrate [how the invention may be adapted to] inlet ports having sleeve-like constructions. Referring to Fig. 9, the distal end 14 of the air hose 12 has the nozzle 14n in which a slot 14s is cut. An edge 14e of the slot is exposed and elements of conductive material 57m are placed on the edge 14e, in opposition across the slot 14s. The inlet port 11 is embodied in a sleeve 70 of material that extends from and opens into an inflatable thermal device (not shown). An alignment and contact mechanism 72 is mounted on the inside of the sleeve 70 by appropriate means including, for example, gluing between the inside surface of the sleeve and the upper surface 72u of the alignment mechanism 72. The alignment mechanism 72 may be a molded plastic piece that generally has the shape of the slot 14s and includes a peripheral slot-like recess 72s that receives the edge 14e of the slot 14s. A strip of conductive material 55m is disposed in the alignment mechanism 72, protruding in the opposed places into the peripheral slot-like recess 72s. When the slot 14s is seated on the alignment mechanism 72, an electrical circuit is completed or closed between the conductive material elements 57m by way of the strip of conductive material 55m. In Figs. 10A and 10B, the end of the sleeve 70 has an elastic material integrated into the material of the sleeve 70 to form an elastic portion 70e. On the inside surface of the elastic portion 70e a ring of conductive material 55m is attached. The distal end 14 of the air hose 12 has substantially the same construction as that illustrated in Figs. 6A and 6B, with the exception that the circumferential groove 14g is omitted. To join, couple, the distal end 14 in the inlet port 11 via the sleeve 70, the elastic region 70e is expanded, and the distal end 14 is slid into the sleeve 70 until the collar 14c is in the portion of the elastic region 70e that is girded on its inside surface by the ring of conductive material 55m, which closes or otherwise completes an electrical pathway between the conductive elements 57s. The nozzle 14n is retained in the sleeve 70 by the grip of the elastic region 70e on the nozzle's outside surface.

Page 17, line 27 through Page 18, line 16:

Figs. 11A through 11C illustrate the inflatable thermal device where the inlet port 100 includes a hose card 102. It should be understood that the inlet port 100 and hose card 102 are typically a component of an inflatable thermal device which is not shown as an effort to simplify the drawings. The hose card 102 is used to provide the first circuit element electrical connection and to provide mechanical stability to the air hose/inlet port interface. As shown in Figs. 6A, 6B, 7, 10A, and 10B, the first circuit element 104 is annular, surrounding the inlet port 100. This permits the first, or distal end 106 of air hose 108 to freely rotate in the inlet port 100

without a loss of electrical continuity. The first hose end also includes the second circuit element, two electrical contacts 110a and 110b are shown, but in some aspects [of the invention] the second circuit element is a single electrical contact. The second circuit element 110a/110b cooperates with the first circuit element to enable a signal representing a connection between the first end 106 of the air hose 108 and the inlet port 100. As mentioned above, the connection is made independent of the rotational alignment of the air hose in the inlet port. The rotational alignment is represented by reference designator 112. In a simple aspect [of the invention], the first 104 and second 110a/110b circuit elements are electrical contacts, the joining of which completes an electrical circuit, signifying that the air hose 108 is properly mated in the inlet port 100. As is explained in more detail below, that connection of first 104 and second 110a/110b circuit elements can be used to conduct signals with information content which permit a more complex determination of the condition of the air hose 108 in the inlet port 100.

Page 18, lines 17 through 23:

In one aspect [of the invention], as shown, the first circuit is made up of a plurality of members, such as member 114, which have a saw-tooth shape ending in a peak pointing toward the center of the inlet port 100. Typically, the hose card is made of cardboard, or some similarly pliable material so that as the air hose first end 106 is inserted in the inlet port 100, the members 114 are deformed. Due to the tooth shape of the members 114, which increases in thickness in moving towards the base of the tooth, the members gradually stiffen as the first hose end 106 is inserted.

Page 19, lines 8 through 22:

To complete the electrical connection required for the first 104 and second 110a/110b circuit elements to cooperate, the first circuit element deformable members 114 have a surface coated with a conductive ink. The ink can include conductive elements such as copper, silver, and carbon, but [the invention] is not limited to the use of just the named connective elements. One conductive ink found to be effective is manufactured by Acheson, under the part number of SS 24600. The conductive ink can be formulated to have a known resistance, permitting the controller to differentiate between different types of thermal devices. For example, it may be desirable to have the controller operate the blower under a first set of temperature and airflow parameters when a first kind of inflatable thermal device, having a first resistance measurement, is connected to the air hose. The control circuit is able to measure and recognize different

resistance values, correlate these resistance measurements to corresponding inflatable thermal devices, and modify the temperature and airflow parameters in response to the measured resistance, so that a variety of inflatable thermal device can be operated at predetermined parameters from a single blower unit.

Pages 19, line 23 through Page 20, line13:

Figs. 12A through 12C illustrate an alternate aspect of the air hose 108 of Fig. 11A or the air hose 12 of Figs. 6A, 6B, 7, 10A, and 10B. That is, the second circuit element to be described can be used with a variety of first circuit element designs, including the hose card first circuit element. The air hose first end 106 is manufactured from a partially resistive material, such as a conductive polymer, in which electrical conductivity can be varied by loading the material with conductants such as carbon. These materials have a surface conductivity in-between standard plastics and metal. Conductive polymers are lighter than metal, and less subject to denting. The PermaStat® family of products manufactured by the RTP company is an example of such a material. The second circuit element is formed from a highly conductive element, such as metallic wire which is embedded in the polymer material. Two conductive elements 120a and 120b are shown. Electrical current can pass from the polymer nozzle surface to the embedded wires 120a/120b, with the electrical resistance being at a minimum at the surface area immediately overlying the wires. That is, the second circuit element includes the conductive elements 120a/120b and the polymer surface overlying the elements. Further, the first circuit element 104 and second circuit element 110a/110b cooperate to enable a signal between the first circuit element (however defined) and the polymer hose surface immediately overlying the highly conductive element 120a/120b. In other aspects [of the invention], the polymer surface overlying the conductive elements 120a/120b is formed in a separate fabrication process from the deposition of the conductive elements and/or the formation of supporting layer of nozzle material that need not be the highly resistive polymer.

Page 21, lines 7 through 12:

In other aspects [of the invention] (not shown), the air hose has a shape to encourage a particular alignment. That is, the air hose must be rotated to specific position to insert the air hose into the inlet port. In these circumstances the first circuit element no longer need be annular in shape. Further, since the position of the second circuit element contacts are predetermined, the first circuit element can be shaped to bridge the gap between the second circuit element contacts.

Page 21, lines 13 through 19:

Figs. 13A and 13B illustrate an convective warming system using an electronic identification tag 130. The electronic tag 130 provides information. In its simplest form, the tag 130 provides a single bit of information that is used to communicate that an electrical connection has been made. This aspect [of the invention] is similar in concept to the impedance measurement method described above in the explanation of Figs. 12A-12C. In other aspects [of the invention] the electronic tag 130 provides more information, which in turn, permits a wider range of responses.

Page 21, line 20 through Page 22, line 2:

Communication with the electronic identification tag 130 can be made through a direct-wired-connection, through a modulated magnetically radiated signal, and a modulated electrically radiated signal. When a direct electrical connection is to be made, any of the above-described methods to interface the first 104 and second 110 circuit elements can be used. However, when radiated signals are to be used, the first 104 and second 110 circuit elements must be radiating elements, or antennas, as shown. Interrogation and identification signals are coupled between radiating elements 104 and 110. When radiated signals are used the electronic identification tags are often called radio frequency identifiers (RF IDs). The higher frequency electric fields can generally be propagated a further distance than the magnetic fields, given the same amount of transmit energy. It may be desirable [in some aspects of the invention] to limit interrogations from the second circuit element 110, so that the air hose does not communicate with neighboring inflatable thermal devices outfitted with RF IDs.

Page 22, lines 11 through 27:

Alternately, the identification can contain more information bits. At present, electronic identification tags which provide a 64-bit identification code are common, but [the present invention is] are not limited to any particular message length. Among other things, the multiple-bit message can provide information which describes the inflatable thermal device model number, the inflatable thermal device serial number, the preferred air flow rate, the preferred air temperature, and patient identification. The air flow, temperature, and other parameters can be regulated in response to knowing this information. For example, the preferred air flow characteristics may differ for different inflatable thermal device models. Alternately, the tag 130 can be loaded to provide the patients identity, the number of times the blanket has been

connected to the warming unit, and the amount of time the blanket has been in use. The air flow controlling mechanism can regulate air flow in response to local database of patient characteristics, or the air flow can be established in communication between the air flow controller and a central system. In other aspects [of the invention], the electronic tag is worn by the patient. In some aspects [of the invention] the electronic tag supplies updated patient vital statistics which are downloaded through the air flow controller to a local file, or communicated to the central system.

Page 23, lines 4 through 11:

Figs. 14A, 14B, 15A-15C, 16A, and 16B illustrate [some] examples of mechanical solutions to the problem of controlling air flow to an inflatable thermal device according to the invention. These solutions rely on the act of coupling the air hose into the inlet port to open a valve and permit the flow of air. Likewise, the decoupling of the air hose from the inlet port causes the valve to close, preventing burn accidents or improper operation of the equipment. These solution do not rely upon the engagement of electrical contacts, the relaying of electrical signals, or electronic identification for the system to convectively control the temperature of an inflatable thermal device.

Page 25, line 16 through Page 29, line 2:

[In some aspects of the invention, the mechanical flap concepts are combined with the any of the methods of interfacing the first circuit element with a second circuit element described in Figs. 11A-11C, Figs. 12A-12C, and Figs. 13A and 13 B. These aspects rely on the mechanical valve to permit the flow of air. Information in the electrical signals, whether a simple electrical continuity, resistance measurement, or digital information permit the rate of air flow and air temperature to be regulated.

Fig. 17 illustrates a method for indicating a condition in a system including an inflatable thermal device, corresponding to Figs. 11A-11C, and Figs. 12A-12C. Although depicted as a sequence of steps for clarity, no order should be inferred from the numbering unless explicitly stated. In Step 200 at least one annular inlet port, at least one surface adapted to expel air, and an air hose are included with the pressurized thermal device. The air hose has two ends for delivering a flow of pressurized air to the inflatable thermal device when one end is coupled to the inlet port. Step 202 inserts an end of the air hose into the inlet port of the pressurized thermal device. In Step 204 the pressurized thermal device is operated by conducting a flow of pressurized air through the air hose. Step 206 senses at the inlet port a condition between the

inlet port and the end of the air hose, independent of the rotational alignment of the air hose in the inlet port. Step 208 is a product where the conduction of air flow is responsive to the sensed condition.

The sensing of a condition in Step 206 includes the inlet port forming an electrical connection between the inlet port and the end of the hose. The response to the sensed conditions in Step 208 includes delivering pressurized air in accordance with a first set of parameters when an electrical connection is made between the inlet port and the air hose end, and delivering air in accordance with a second set of parameters when no electrical connection is made between the inlet port and the air hose end. Some parameters which can be varied are flow rate and air temperature.

In some aspects of the invention Step 200 includes an inlet port that is formed in a hose card having a plurality of deformable members. Then, the insertion of the air hose into the inlet port in Step 202 includes the hose card members gradually stiffening to capture the air hose as the air hose is inserted into the inlet port. Typically, Step 200 includes a hose card where the gradually stiffening members have a surface coated with a conductive ink. Then, the sensing of a condition at the inlet port in Step 206 includes forming an electrical connection across the hose card ink surface. As noted above, the conductive ink is made from conductive elements selected from the group of graphite, copper, silver, and carbon, such the conductive ink is manufactured by Acheson, part number SS 24600, which contains graphite.

In some aspects of the invention Step 200 includes an air hose end with an electrical contact formed in an annular groove around the outside surface of the hose end which interfaces with the inlet port. Then, the insertion of the air hose into the inlet port in Step 202 includes capturing the deformed hose card members in the annular groove, and the sensing of the condition at the inlet port in Step 206 includes forming an electrical connection between the electrical contact in the annular groove of the air hose end and the hose card conductive ink.

Alternately, Step 200 includes a second circuit element electrical contact (on the hose end) formed from a highly conductive element underlying the surface of the air hose first end made from a high resistivity polymer. Then, the sensing of the condition at the inlet port in Step 206 includes forming an electrical connection between the highly resistive polymer surface overlying the highly conductive element and the first circuit element.

Regardless of how the first and second circuit elements are formed, Step 200 includes a first circuit element having a first resistance and the second circuit element having a second resistance. Then, the sensing of the condition at the inlet port in Step 206 includes measuring the impedance of the electrical connection formed by the first and second circuit elements. In

some aspects of the invention the response to the measuring of the impedance formed by the connection of the first and second circuit elements in Step 206 includes Step 208 delivering air in accordance with a set of parameters which is responsive to the measured impedance. That is, different airflows and air temperatures can be delivered for different impedances.

Fig. 18 is a flowchart illustrating a method for indicating a condition in a system including an inflatable thermal device, corresponding to Figs. 13A and 13B. Step 300 includes at least one inlet port having an electronic identification tag, at least one surface adapted to expel air, and an air hose with the inflatable thermal device. The hose has two ends for delivering a flow of pressurized air to the inflatable thermal device when one end is coupled to the hose card. Step 302 inserts an end of the air hose into the inlet port of the inflatable thermal device. Step 304 communicates with the electronic identification tag. Step 306 identifies the inflatable device at the inlet port. Step 308 is a product where the operation of the inflatable thermal device, by conducting a flow of pressurized air through the air hose, is responsive to identifying the inflatable thermal device.

In some aspects of the invention Step 300 includes the inlet port having an electrical contact and the air hose end has an electrical contact. Then, the communication with the electronic identification tag in Step 304 includes completing a direct electrical contact between the inlet port contact and the air hose end contact. Alternately, Step 300 includes the inlet port having a radiating element and the air hose end having a radiating element. Then, the communication with the electronic identification tag in Step 304 includes coupling signals between the inlet port radiating element and the air hose end radiating element.

Step 300 can include the electronic identification tag having a 1-bit identification code, so that the communication with the electronic identification tag in Step 304 includes communicating the 1-bit identification code. Alternately, the tag provides a plurality of bits in the code, such as 64 bits, so that the communication with the electronic identification tag in Step 304 includes communicating the 64-bit identification code. Multi-bit codes permit the communication of information in Step 304 such as the inflatable thermal device model number, the inflatable device serial number, the number of times the inflatable thermal device has been attached, the amount of time the inflatable thermal device has been used, the preferred air flow rate, the preferred air temperature, and the identification of the patient. Thus, it is possible to deliver pressurized air (Step 308) in accordance with a plurality of selectable parameters, where the parameters define such variables as temperature and pressure or flow rate. The parameters selected are responsive to the identification made in Step 306.

In some aspects of the invention Step 300 includes an inflatable device with a power supply connected to the electronic identification tag. Then, the communication with the electronic identification tag in Step 304 includes powering the electronic identification tag with the power supply. Alternately, Step 300 includes the power supply being permanently connected to conductive elements in the air hose. Then, the communication with the electronic identification tag in Step 304 includes connecting the air hose to the inlet port to provide power to the electronic identification tag.

Figs. 11A through 13A, and Figs. 17-18 describe sensors and sensing methods that vary from the measurement of a simple on/off electrical connection, through the measurement of resistance, to sophisticated identification schemes. These sensing mechanisms and methods permit airflow to be terminated if a disconnection is sensed, or airflow to be regulated after the mating inflatable thermal device is identified. However, inflatable thermal devices must also be used in emergency situations, or to prewarm bedding or clothing prior to use, with whatever equipment is available at the time. In these situations it may be desirable to have the blower unit deliver a predetermined lower temperature or lower pressure airflow, even if a disconnect is sensed, or if the inflatable thermal device cannot be identified, as an alternative to shutting off. It may also be desirable to set an alarm which communicates an improper connection or unidentified inflatable thermal device, and then permit the operator to perform a manual override.]

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Fig. 17 [19] is a flowchart illustrating a method for controlling air flow in a system including an inflatable thermal device, corresponding to Figs. 14A-14B, 15A-15C, and 16A-16B. Step 400 includes the inflatable thermal device having at least one inlet port, at least one surface adapted to expel air, and an air hose having two ends and a valve to prevent the delivery of a flow of pressurized air to the inflatable thermal device. Step 402 inserts an end of the air hose into the inlet port of the inflatable thermal device. Step 404, in response to inserting the air hose into the inlet port, opens the valve. The opening of the valve in Step 404 includes the valve cooperating with the inlet port. Step 406 is a product where the inflatable thermal device is operated by conducting a flow of pressurized air through the air hose.

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Clearly, other embodiments and modifications of the present invention will occur readily to those of ordinary skill in the art in view of these teachings. For example, [in] inflatable

thermal devices may have [with] more than one inlet port [, one, some, or all of the inlet ports may have first circuit elements as illustrated in the figures]. Also, a heater/blower unit with more than one air hose may fall within the scope of this invention. Further, the invention may be applied to convective systems having the elements of Fig. 1 that cool persons, animals, or things. Therefore, this invention is to be limited only by the following claims, which include all such embodiments and modifications.

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